FIG. 1A

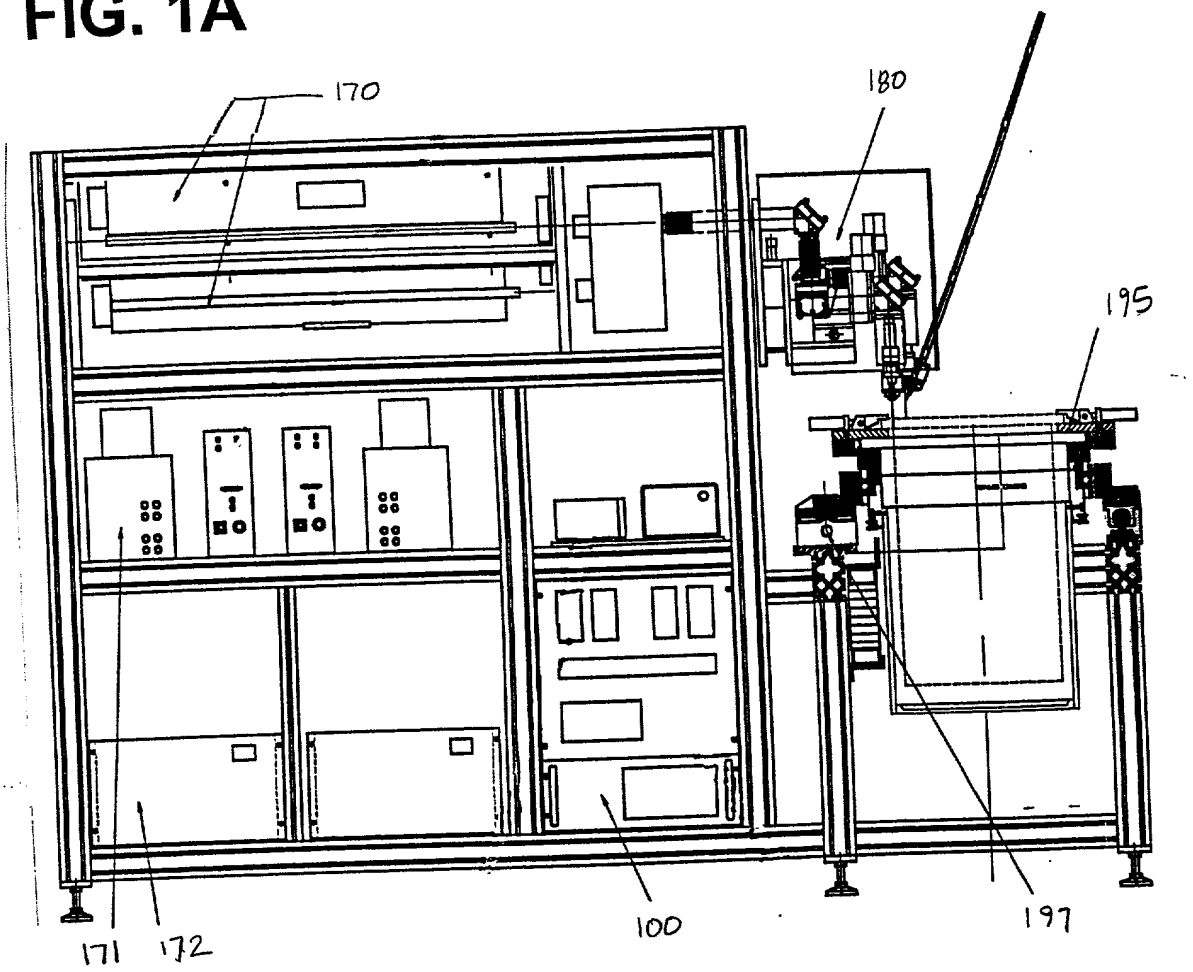


FIG. 1B

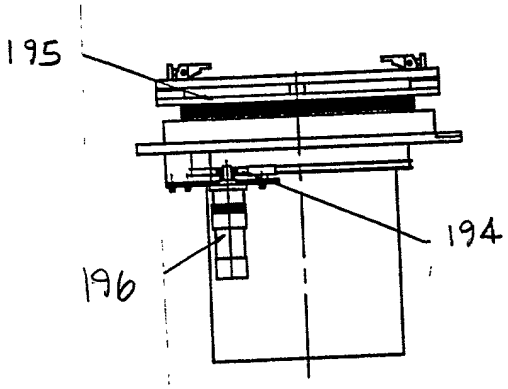


FIG. 1C

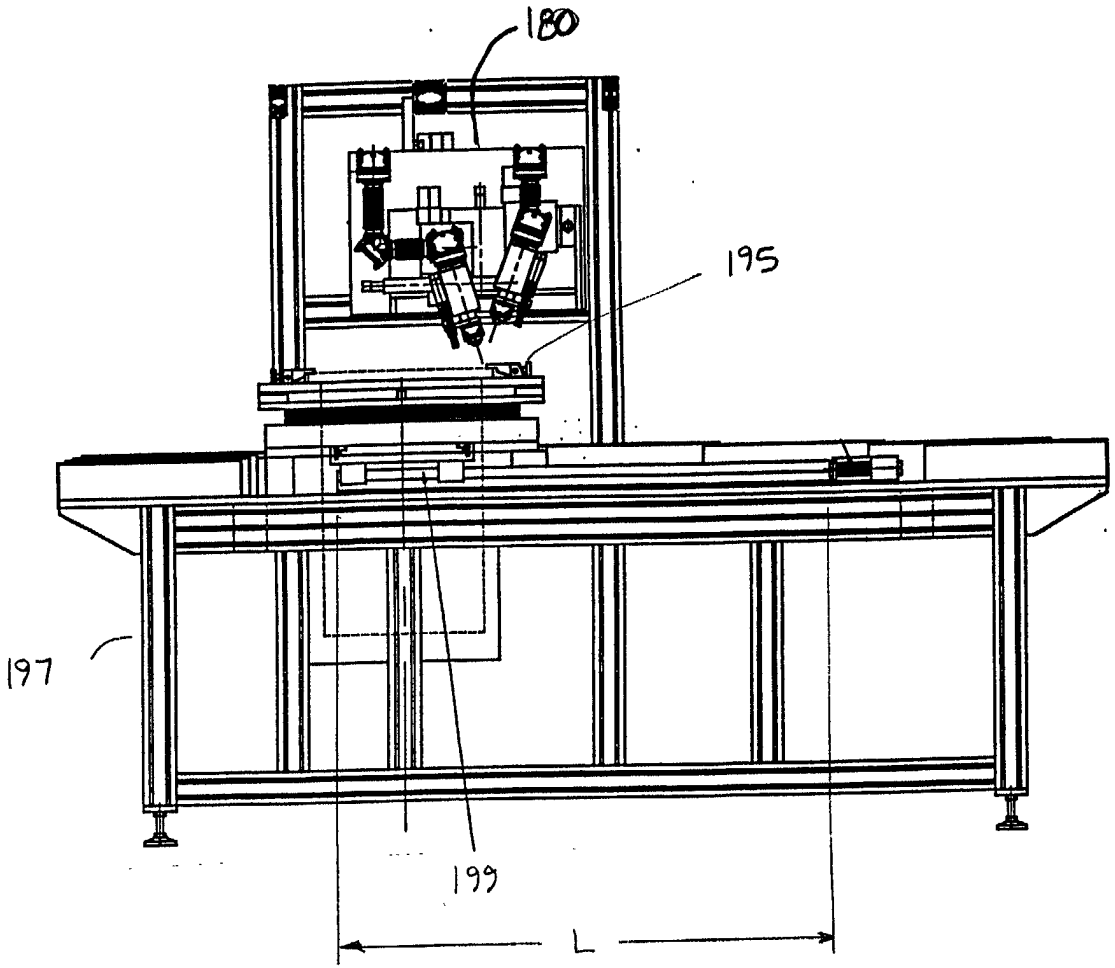


FIG. 1D

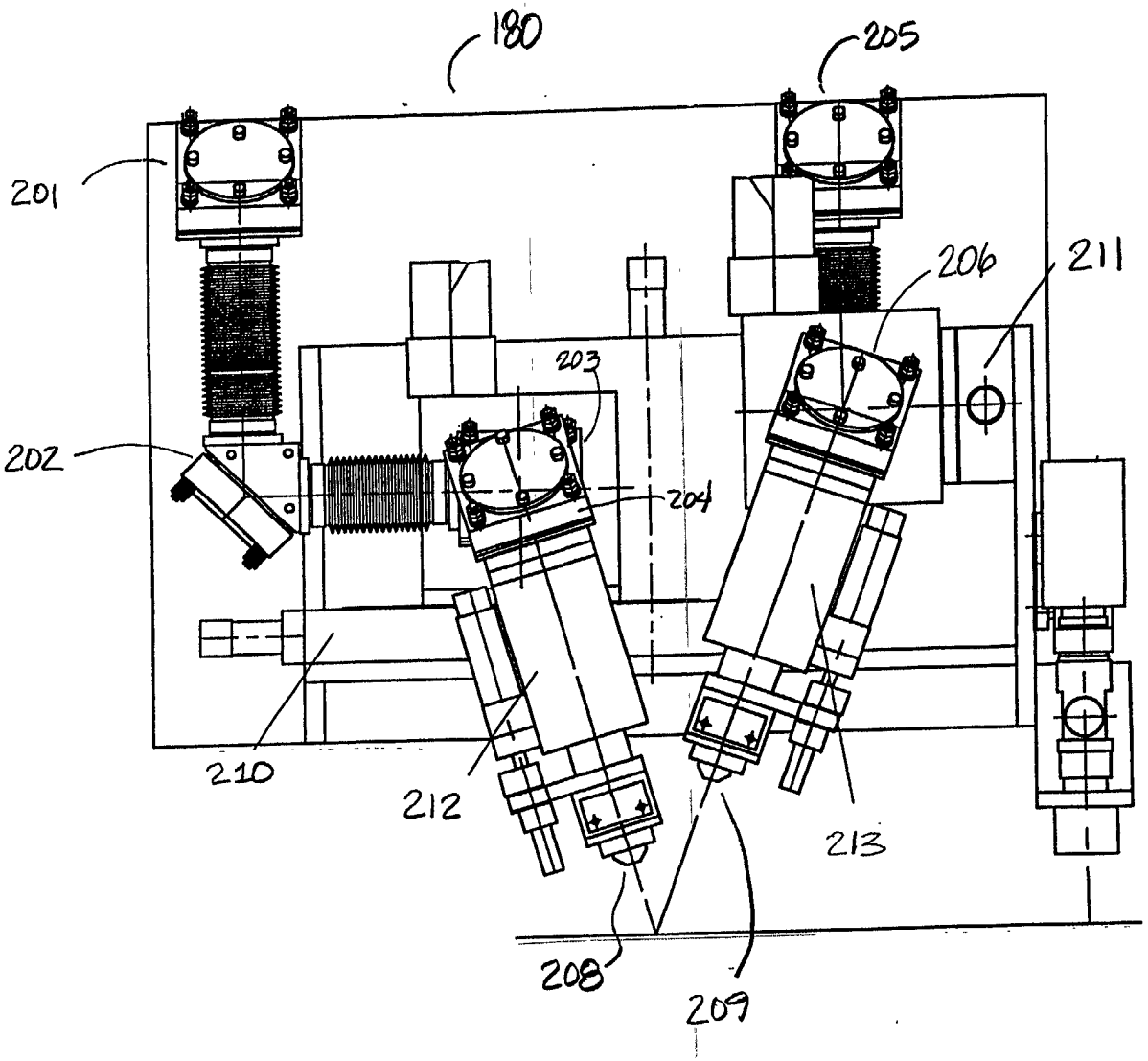


FIG. 2A

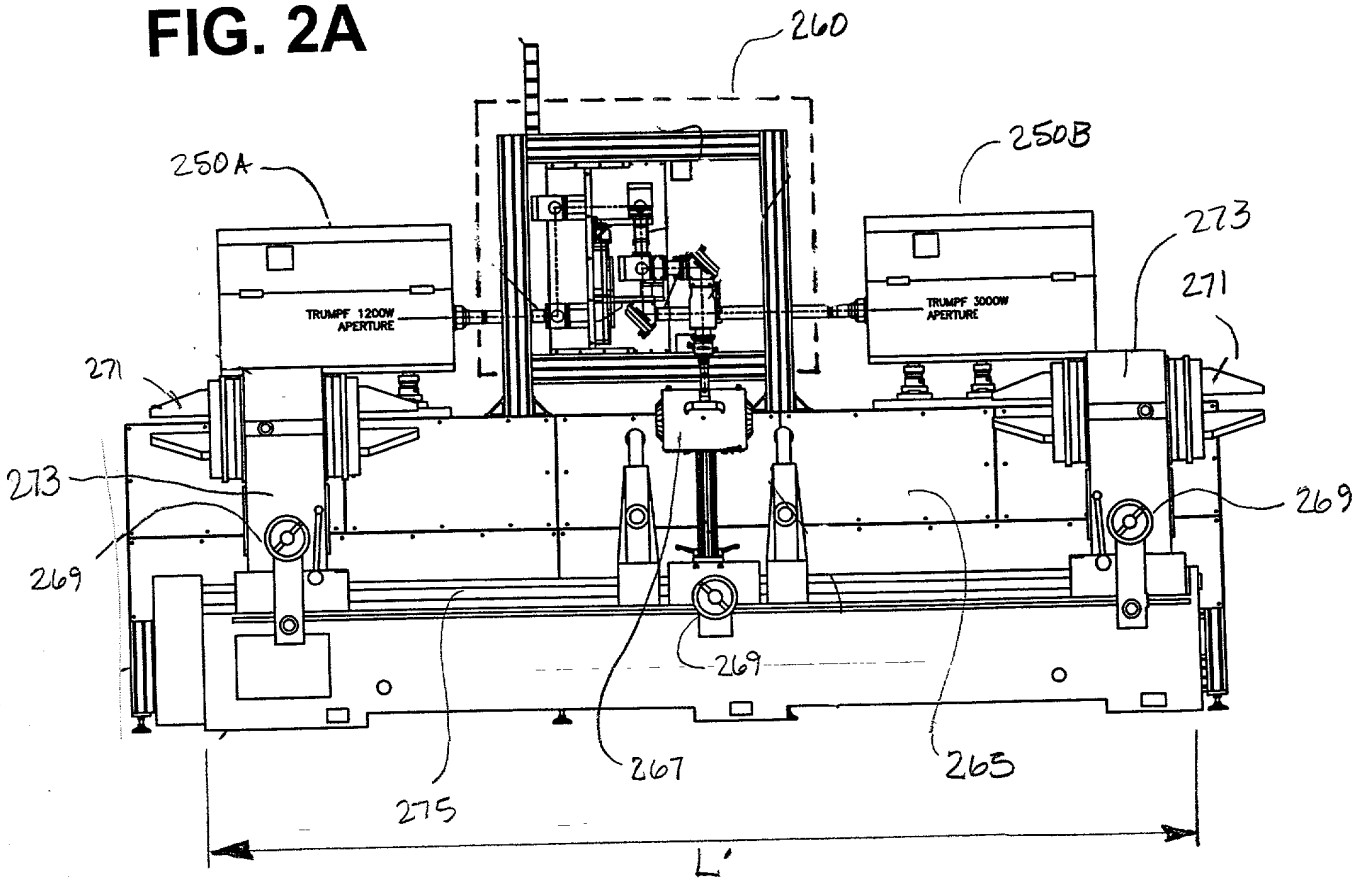

260
250A
250B
273
271
TRUMPF 1200W APERTURE
TRUMPF 3000W APERTURE
271
273
269
269
269
267
265
275
L'

FIG. 2B

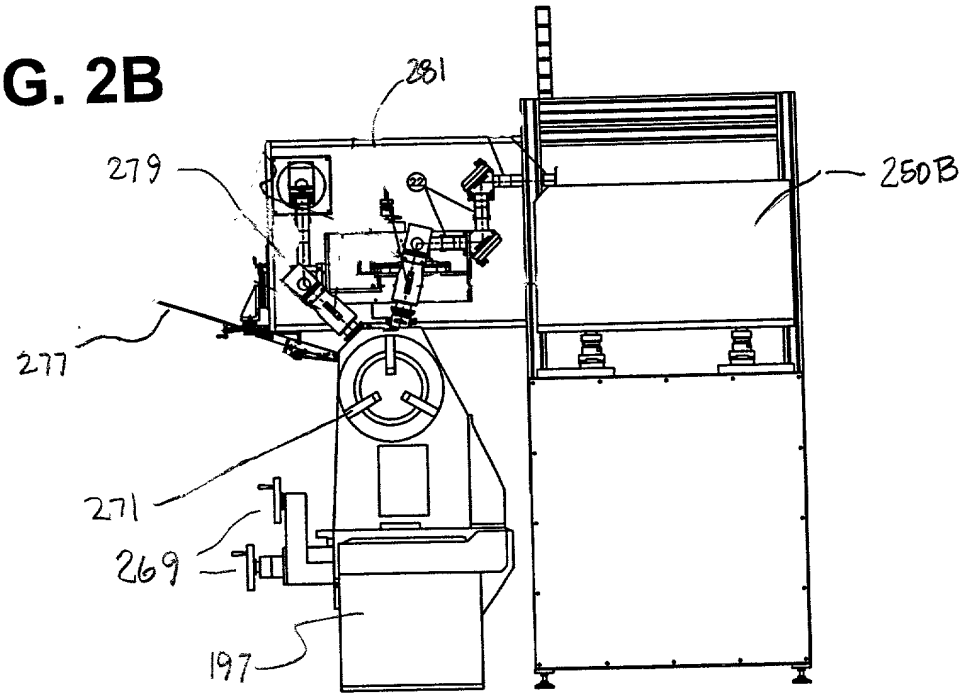

281
279
250B
277
271
269
197

FIG. 3

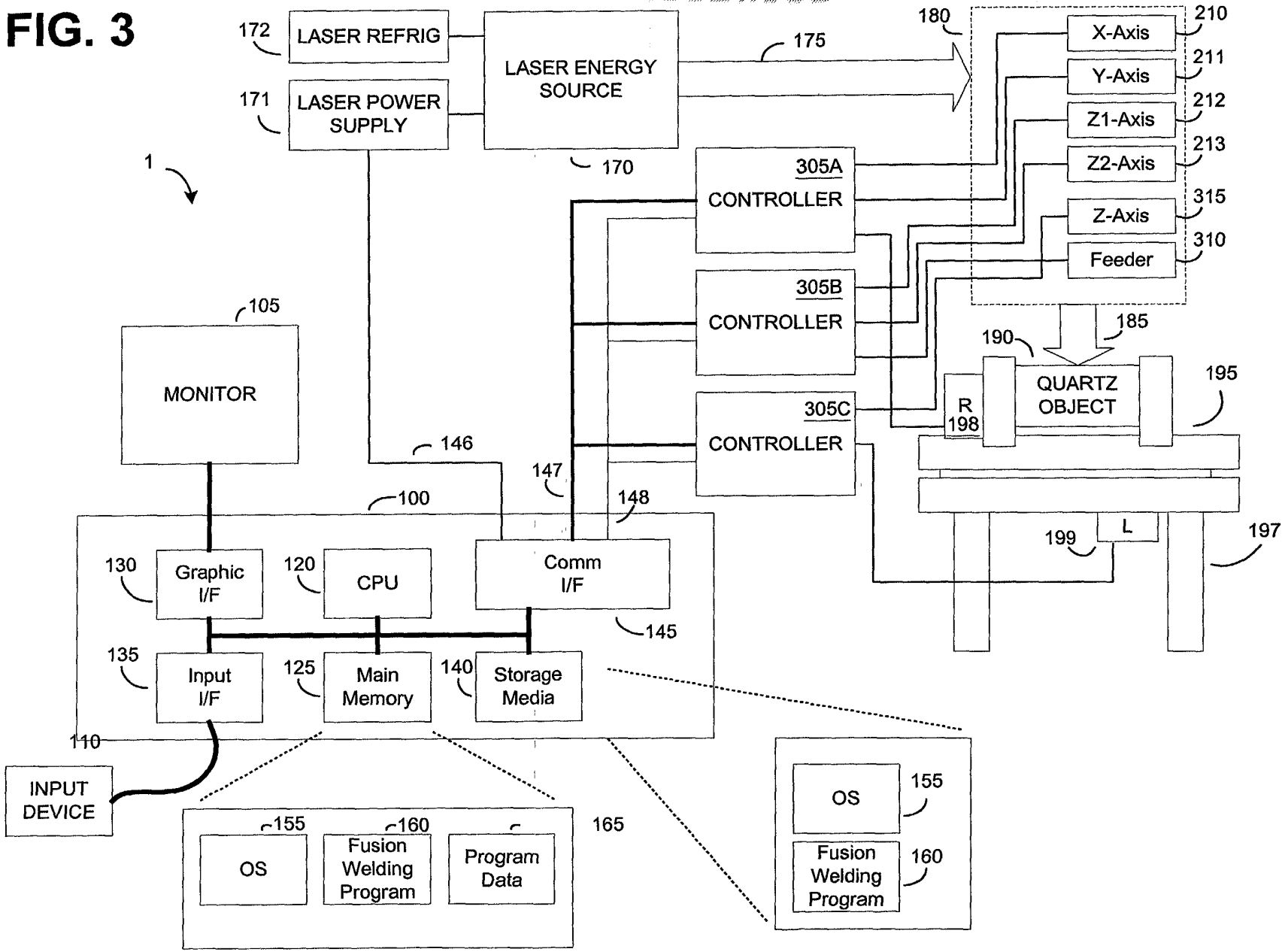

1
172
LASER REFRIG
171
LASER POWER SUPPLY
LASER ENERGY SOURCE
175
170
180
X-Axis
210
Y-Axis
211
Z1-Axis
212
Z2-Axis
213
Z-Axis
315
Feeder
310
305A
CONTROLLER
305B
CONTROLLER
305C
CONTROLLER
105
MONITOR
185
190
QUARTZ OBJECT
195
R
198
146
147
148
100
130
Graphic I/F
120
CPU
Comm I/F
145
135
Input I/F
125
Main Memory
140
Storage Media
199
L
197
110
INPUT DEVICE
155
OS
160
Fusion Welding Program
Program Data
165
155
OS
Fusion Welding Program
160

FIG. 4A

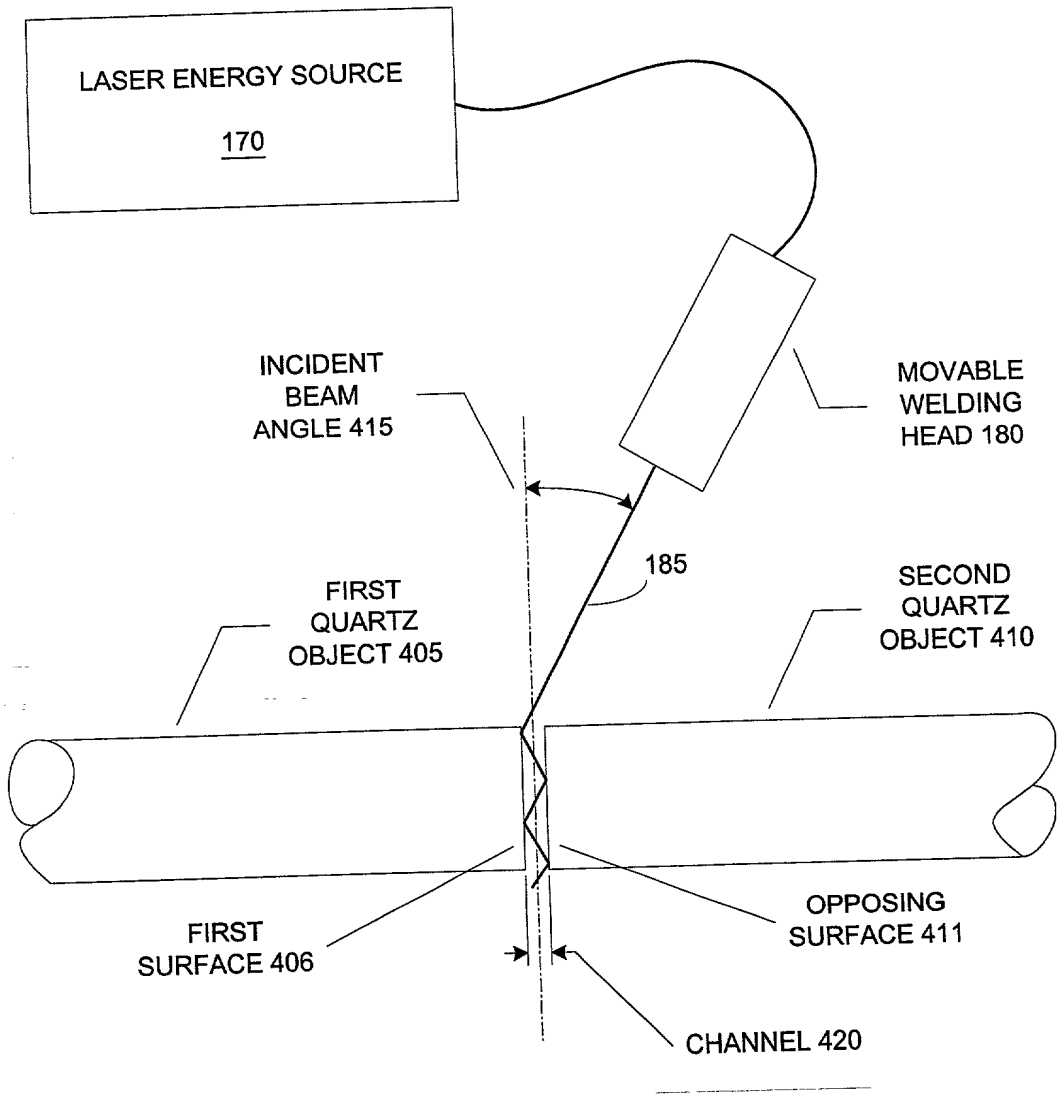

LASER ENERGY SOURCE
170
INCIDENT BEAM ANGLE 415
MOVABLE WELDING HEAD 180
185
FIRST QUARTZ OBJECT 405
SECOND QUARTZ OBJECT 410
FIRST SURFACE 406
OPPOSING SURFACE 411
CHANNEL 420

FIG. 4B

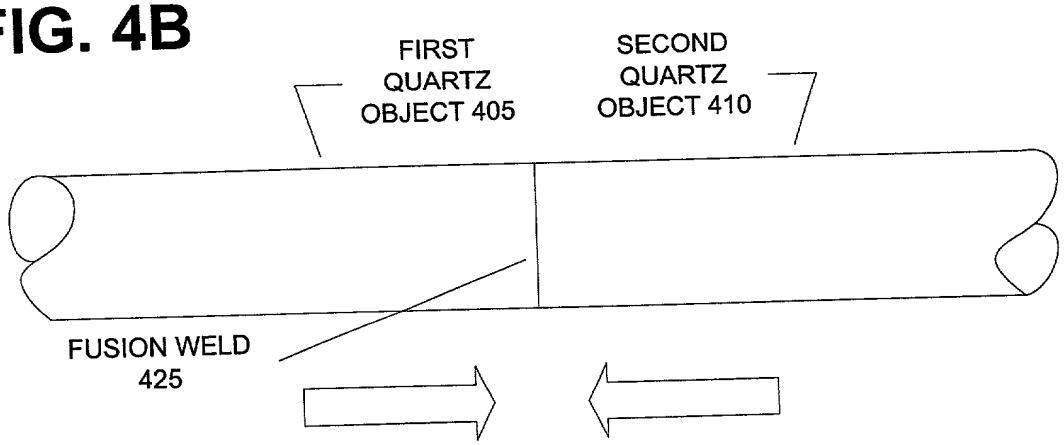

FIRST QUARTZ OBJECT 405
SECOND QUARTZ OBJECT 410
FUSION WELD 425

FIG. 5

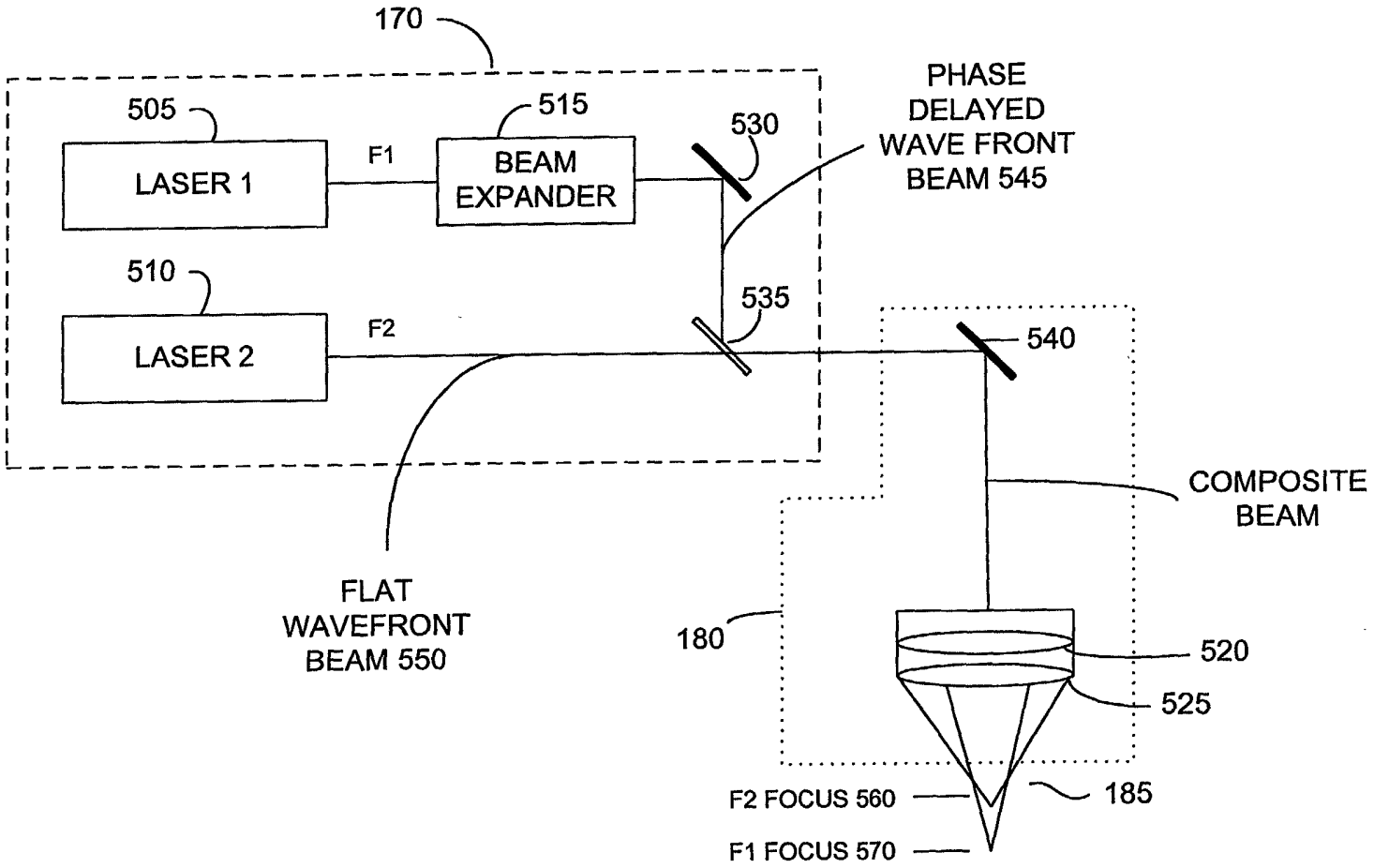

170
505
LASER 1
F1
515
BEAM EXPANDER
530
PHASE DELAYED WAVE FRONT BEAM 545
510
LASER 2
F2
535
540
COMPOSITE BEAM
FLAT WAVEFRONT BEAM 550
180
520
525
F2 FOCUS 560
185
F1 FOCUS 570

FIG. 6A

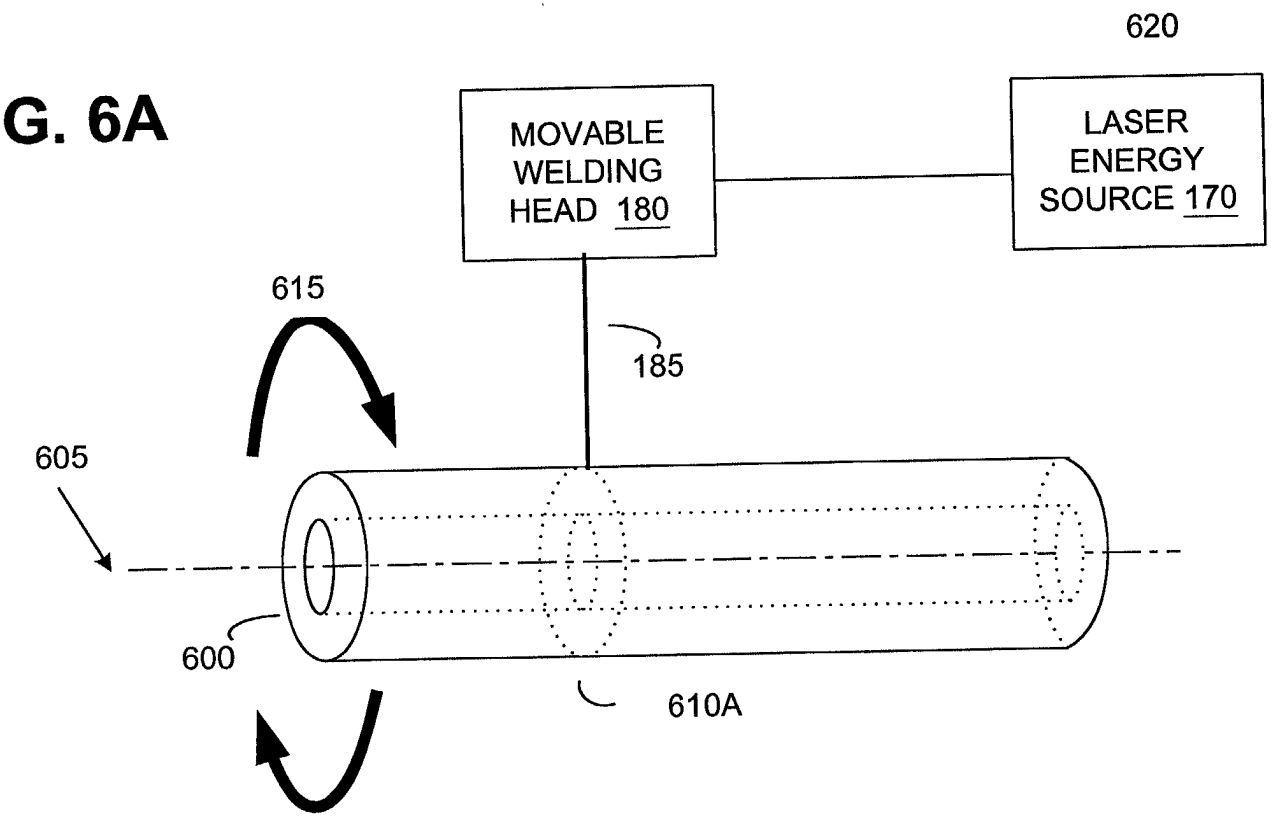


FIG. 6B

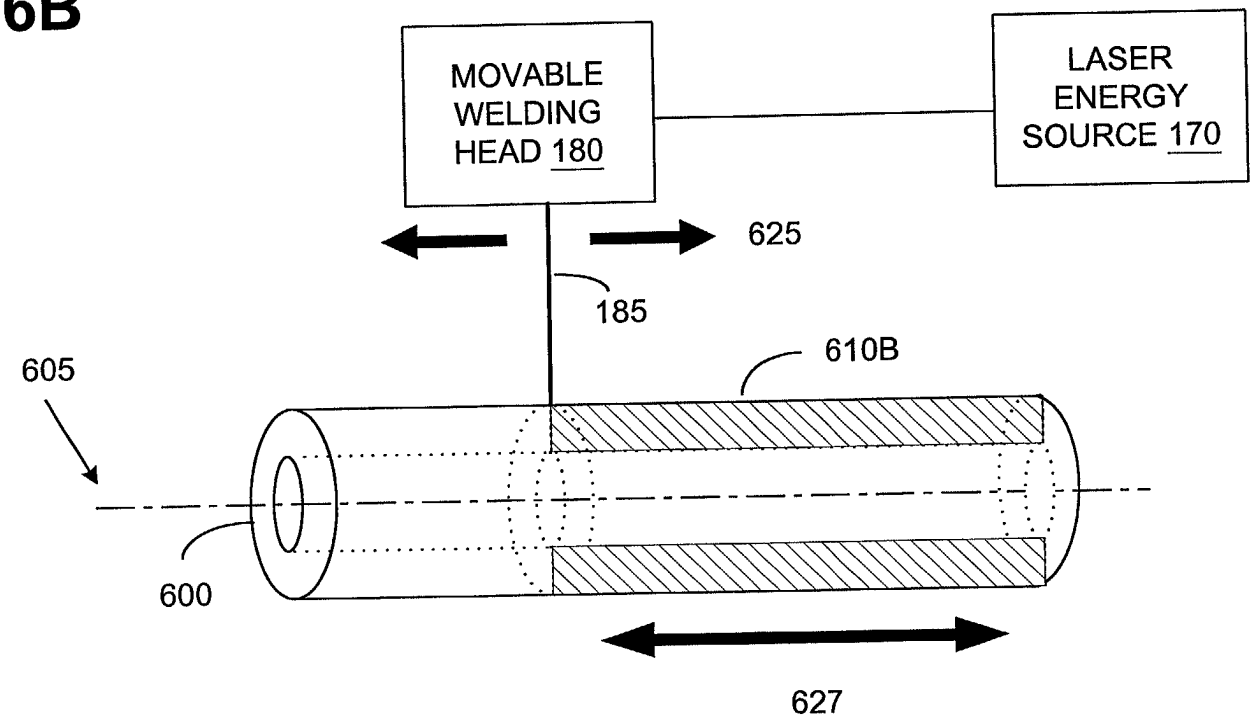

MOVABLE WELDING HEAD 180
LASER ENERGY SOURCE 170
625
185
610B
605
600
627

FIG. 6C

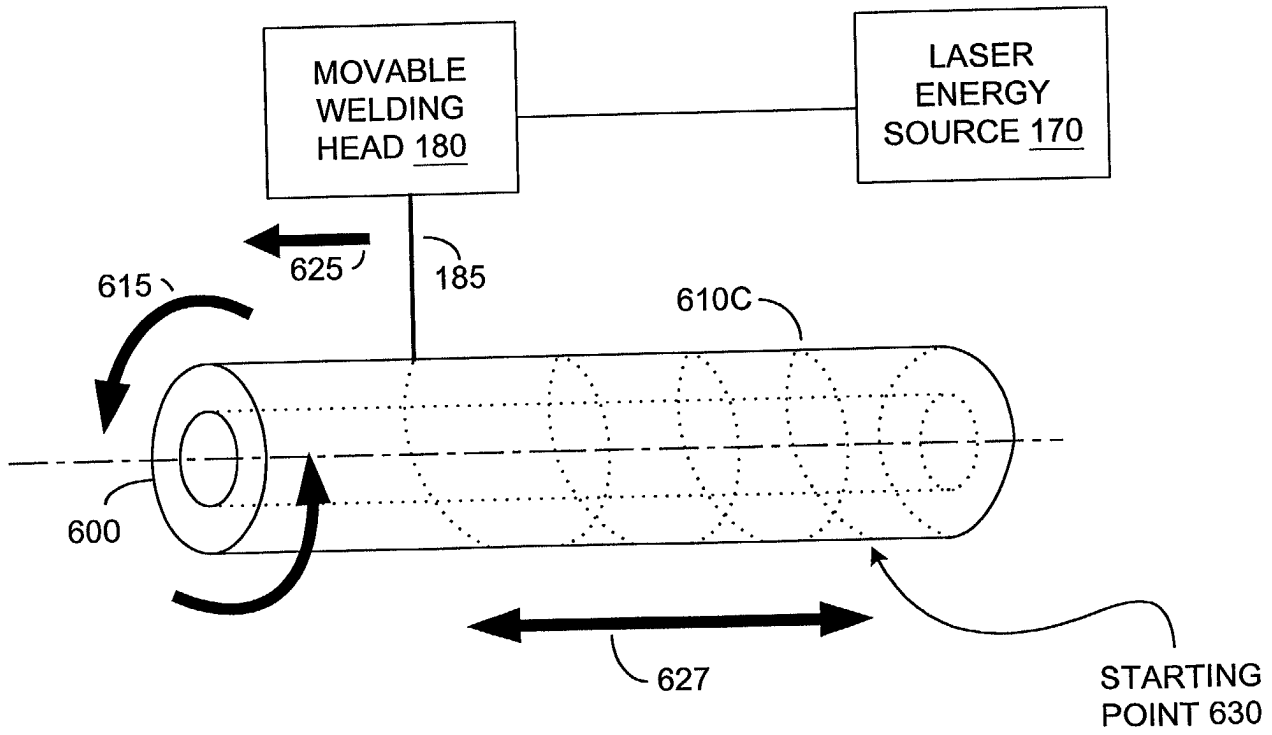

MOVABLE WELDING HEAD 180
LASER ENERGY SOURCE 170
625
185
615
610C
600
627
STARTING POINT 630

FIG. 7A

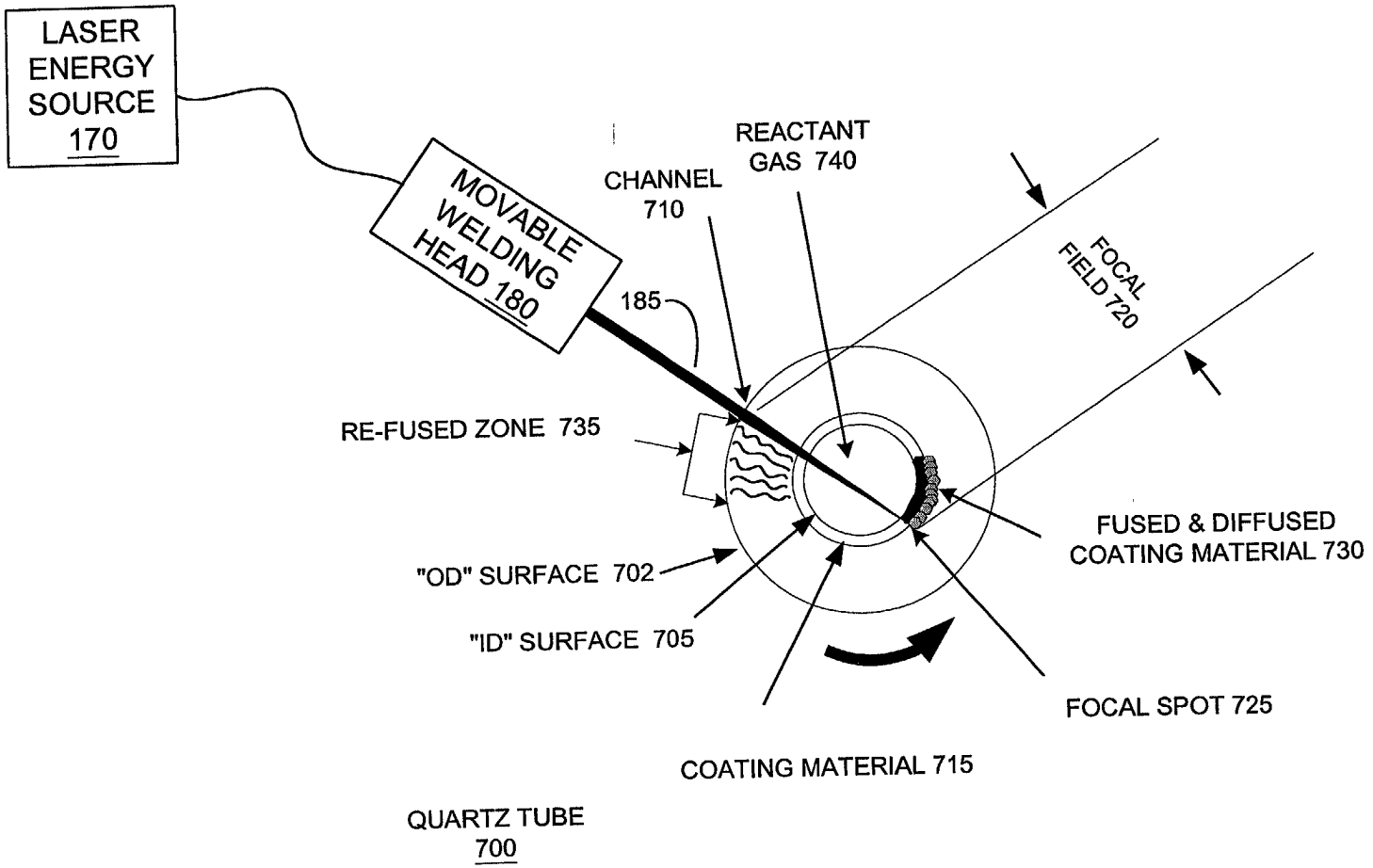

LASER ENERGY SOURCE 170
MOVABLE WELDING HEAD 180
CHANNEL 710
REACTANT GAS 740
FOCAL FIELD 720
185
RE-FUSED ZONE 735
FUSED & DIFFUSED COATING MATERIAL 730
"OD" SURFACE 702
"ID" SURFACE 705
FOCAL SPOT 725
COATING MATERIAL 715
QUARTZ TUBE 700

FIG. 7B

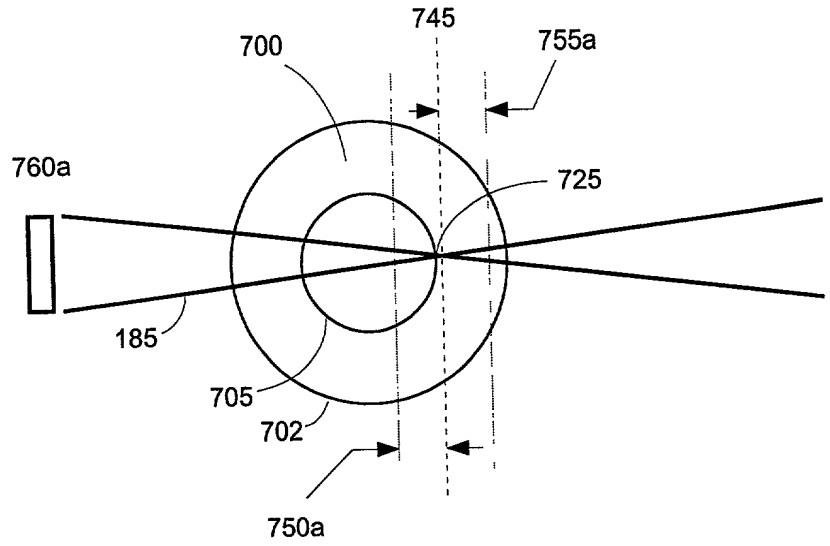

745
700
755a
760a
725
185
705
702
750a

FIG. 7C

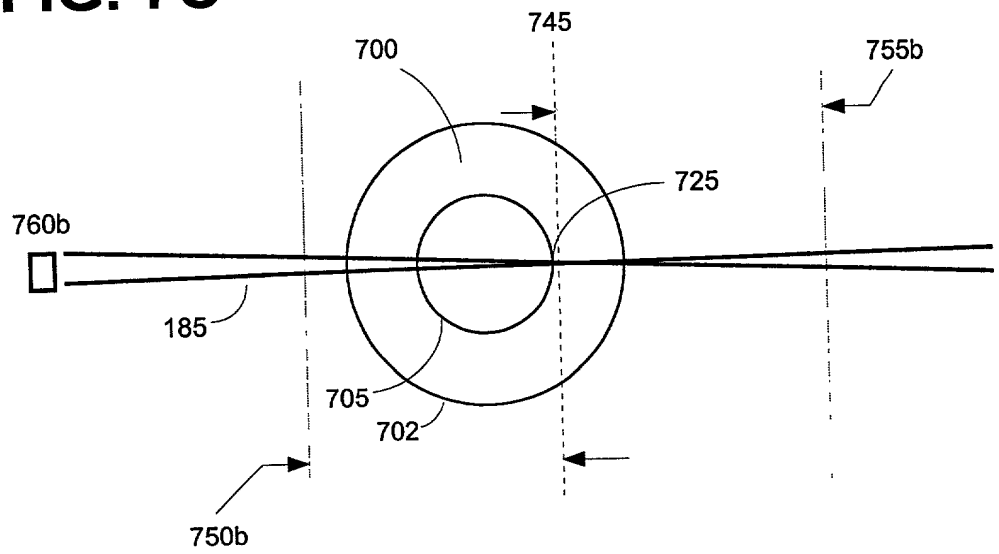

745
700
755b
725
760b
185
705
702
750b

FIG. 8A

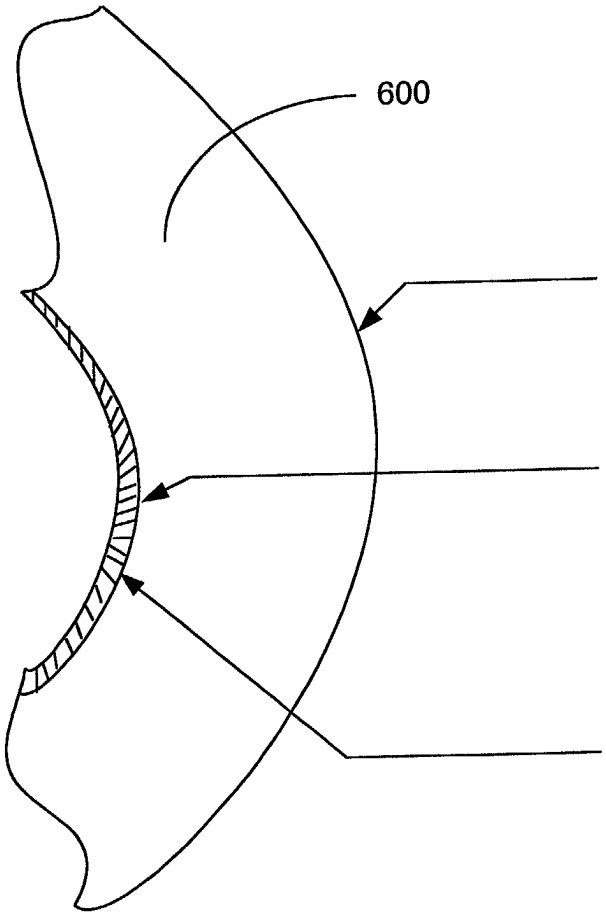

600

FIG. 8B

600
THIN FILM DIFFUSION LAYER 830A
OD SURFACE 702
ID SURFACE 705
METAL COATING MATERIAL 715
THICK (DEEP) BODY DIFFUSION ZONE 830B

FIG. 9

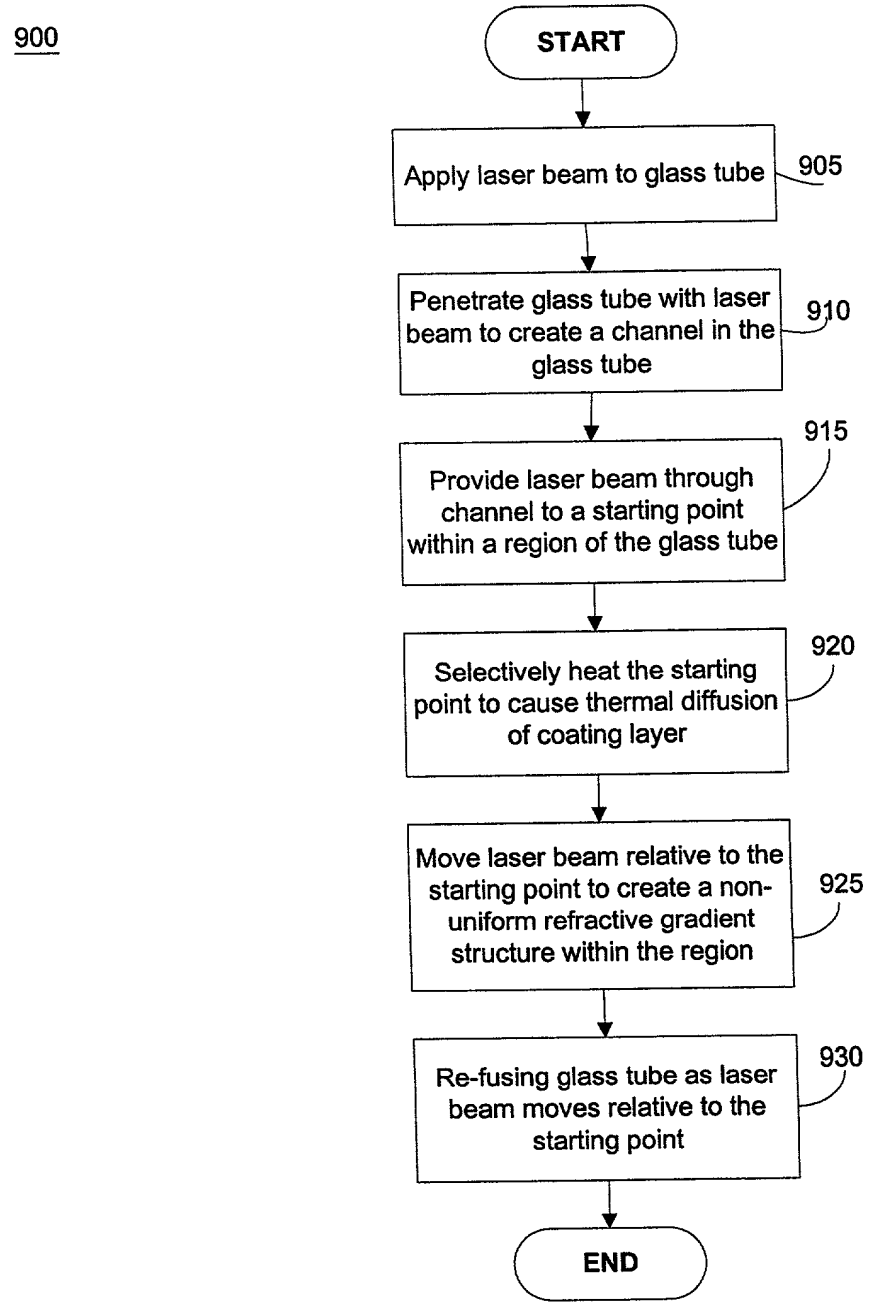
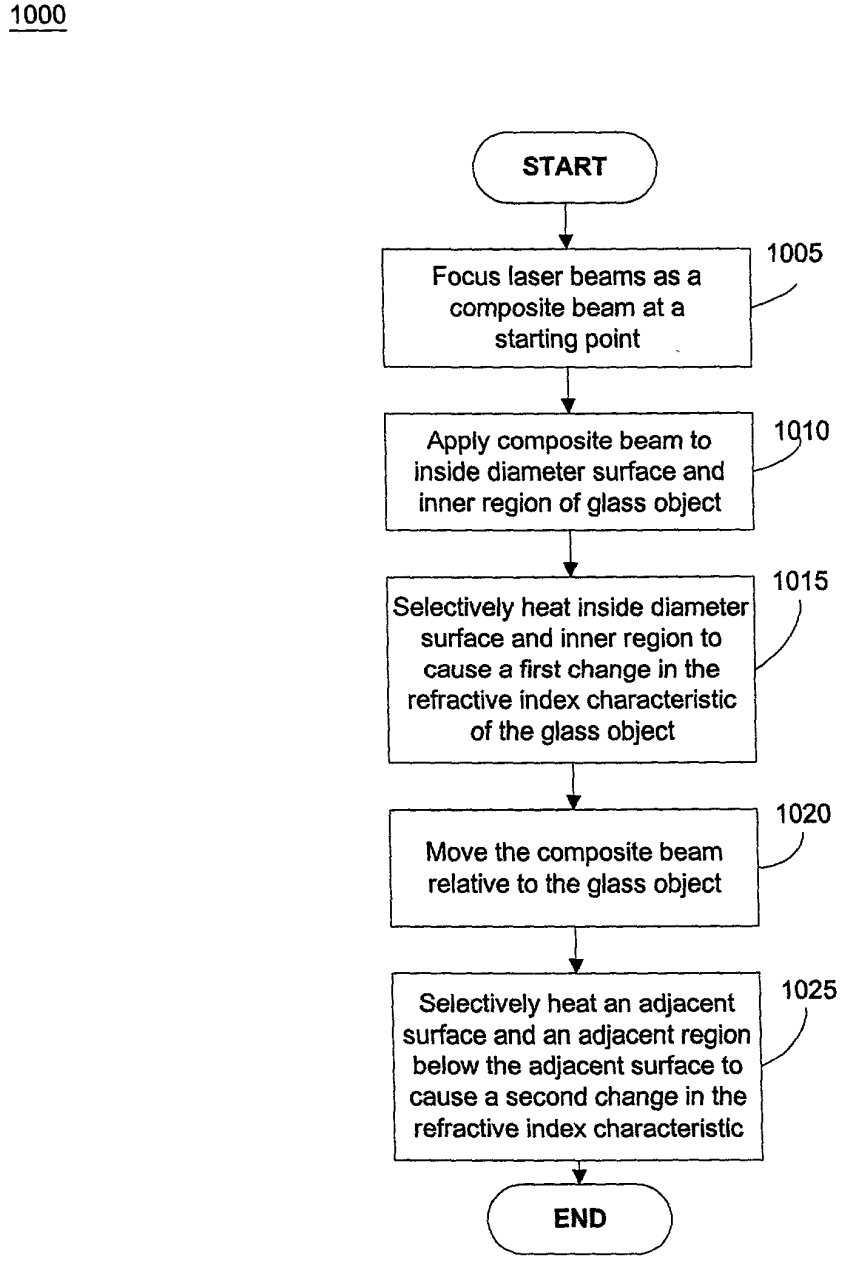

900
START
Apply laser beam to glass tube
905
Penetrate glass tube with laser beam to create a channel in the glass tube
910
Provide laser beam through channel to a starting point within a region of the glass tube
915
Selectively heat the starting point to cause thermal diffusion of coating layer
920
Move laser beam relative to the starting point to create a non-uniform refractive gradient structure within the region
925
Re-fusing glass tube as laser beam moves relative to the starting point
930
END

FIG. 10


1000
START
Focus laser beams as a composite beam at a starting point
1005
Apply composite beam to inside diameter surface and inner region of glass object
1010
Selectively heat inside diameter surface and inner region to cause a first change in the refractive index characteristic of the glass object
1015
Move the composite beam relative to the glass object
1020
Selectively heat an adjacent surface and an adjacent region below the adjacent surface to cause a second change in the refractive index characteristic
1025
END